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JPRS-CST-90-024 25 September 1990

CONTENTS

MICROELECTRONICS

TELECOMMUNICATIONS R&D

Key Laboratories Supported by the State Science and Technology Commission

90P60065A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 28 Jul 90 p 2

[First Group of Key Open Laboratories Supported by the State Science and Technology Commission]

[Text]

I. Group A (17 laboratories)

(A) National Key Laboratories

1. Laboratory of Solid Microstructural Physics (Nanjing University)

2. Analytical Laboratory of Metal Fracture and Materials Failure Analysis (Institute of Metals Research, Shenyang)

3. Laboratory of Elemental Organic Chemistry (Nankai Univ.)

4. Laboratory of Infrared Physics (Shanghai Institute of Technical Physics)

5. Laboratory of Biological Macromolecular Structure (Institute of Biophysics, Beijing)

6. Numerical Simulation Laboratory of Atmospheric Science and Earth Fluid Mechanics (Institute of Atmospheric Physics, Beijing)

7. Laboratory of Combustion Science for Internal Combustion Engines (Tianjin Univ.)

8. Laboratory of Resources and Environmental Information System (Geography Research Institute, Beijing)

9. Laboratory of Genetic Engineering (Fudan Univ.)

10. Research Laboratory for New Drugs (Institute of Pharmacology, Shanghai)

(B) Departmental Open Laboratories

1. Laboratory of Loess and Quaternary-Period Geology (Institute of CAS, Xi'an)

2. Laboratory of Corrosion Science (Institute of Metal Corrosion and Protection, Shenyang)

3. Laboratory of Structural Chemistry (Fujian Institute of Material Structure)

4. Beijing Laboratory of Vacuum Physics (Scientific Instruments Plant, Beijing)

5. Laboratory of Reproductive Biology (Zoology Institute, Beijing)

6. Laboratory of Solid Atomic Images (Institute of Metal Research, Shenyang)

7. Laboratory of Modern Acoustics (Nanjing Univ.)

II. Group B (45 laboratories)

1. Laboratory of Oncogenes and Related Genes (Shanghai Institute of Oncology)

2. Laboratory of Pattern Recognition (Beijing Institute of Automation)

3. Laboratory of Organic Geochemistry (Institute of Geochemistry, Guangzhou)

4. Laboratory of Semiconductor Super Lattices (Semiconductor Institute, Beijing)

5. Laboratory of Wave Spectra and Atomic Physics (Wuhan Institute of Physics)

6. Laboratory of Natural and Bionic Drugs (Beijing Medical University)

7. Laboratory of Super-High-Speed Laser Spectroscopy (Zhongshan Univ.)

8. Laboratory of Surface Physics (Institute of Physics and Institute of Semiconductors, Beijing)

9. Laboratory of Plant Molecular Genetics (Shanghai Institute of Plant Physiology and Shanghai Institute of Biochemistry)

10. Laboratory of Viral Gene Engineering (Institute of Virology, Chinese Academy of Preventive Medicine)

11. Laboratory of Crystal Material (Shandong Univ.)

12. Laboratory of Visual and Auditory Information (Beijing Univ.)

13. Laboratory of Dynamic Spectra and Static Structure (Chemistry Institute and Beijing University)

14. Laboratory of Molecular Biology (Shanghai Institute of Biochemistry)

15. Laboratory of Applied Organic Chemistry (Lanzhou Univ.)

16. Laboratory of Catalytical Basis (Dalian Institute of Chemical Physics)

17. Laboratory of Veterinary Biology (Harbin Institute of Veterinary Medicine)

18. Joint Laboratory of Sensor Science (Shanghai Institute of Metallurgy, Institute of Semiconductors, et al.)

19. Laboratory of Intelligent Technology Systems (Qinghua Univ.)

20. Laboratory of Fresh Water Ecology and Biological Technology (Institute of Aquatic Biology, Wuhan)

21. Laboratory of Protein Engineering and Plant Gene Engineering (Beijing Univ.)

22. Laboratory of Friction Science (Qinghua Univ.)

23. Laboratory of High Performance Ceramics and Ultra Microstructure (Shanghai Silicate Institute)

24. Ion Beam Laboratory (Shanghai Institute of Metallurgy)

25. Joint Laboratory of Life Sciences, Shanghai (Shanghai Institute of Cell Biology, etc.)

26. Laboratory of Rare Earth Chemistry and Physics (Changchun Institute of Applied Chemistry)

27. Beijing Laboratory of Electron Microscopy (Scientific Instruments Plant, Beijing)

28. Laboratory of Plant Genetics Improvement (Central China Agricultural University)

29. Laboratory of High Energy Laser Physics (Shanghai Institute of Optics and Fine Mechanics)

30. Laboratory of Non-Linear Continuous Medium Mechanics (Institute of Mechanics, Beijing)

31. Laboratory of Clinical Pharmacology of Antibiotics (Shanghai Medical Univ.)

32. Laboratory of Fungus-Lichen System Science (Institute of Microbiology, Beijing)

33. CAD Laboratory (Institute of Computer Technology, Beijing)

34. Laboratory of Systematic and Evolutional Botany (Institute of Botany, Beijing)

35. Laboratory of Experimental Marine Biology (Ocean Institute, Qingdao)

36. Laboratory of Metal Material Strength (Xi'an Jiaotong Univ.)

37. Laboratory of Heavy-Ion Physics (Beijing Univ.)

38. Laboratory of Laser Single-Atom Detection (LSAD) (Qinghua Univ.)

39. Laboratory of System Ecology (Center of Ecological Environment, Beijing)

40. Joint Laboratory of Quantum Optics (Shanghai Institute of Optics and Fine Mechanics)

41. Laboratory of Magnetics (Institute of Physics, Beijing)

42. Laboratory of Structure Engineering and Vibration (Qinghua Univ.)

43. Laboratory of Environmental Fracture—Huanjing Duanlie Shiyan Shi [3883 1064 2451 5933 1395 7526 1358]—(Beijing Science and Technology Univ.)

44. Laboratory of Polymer Material Engineering (Chengdu Science and Technology Univ.)

45. Laboratory of Fine Performance Electronic Materials and Devices (Xi'an Jiaotong Univ.)

More Details on Long March-2 Strap-on Launch Vehicle

90FE0301B Beijing BEIJING KEJI BAO [BEIJING SCIENCE AND TECHNOLOGY NEWS] in Chinese 4 Aug 90 p 1

[Article by Liu Jinzhi [0491 2417 2535] and Wan Jun [5502 6874]]

[Text] At 9:40 a.m. on 16 July 1990, a Chinese-built Long March-2 strap-on launch vehicle lifted off from the Xichang Launch Center, carrying the hopes of China and the Chinese people. The success of this launch raised the payload capability of China's launch vehicle by 8.8 tons. It has also turned a new page in the history of China's space development program and has left the footprints of many new heroes in the space industry.

In November 1988, the Great Wall Industrial Corp. of this country signed a contract with the Hughes Corp. of the United States to launch two Australian satellites built by Hughes in 1991 and 1992 using Chinese launch vehicles.

This presented a challenging problem for Chinese rocket experts because they had to develop China's first high-thrust, strap-on launch vehicle within a period of 18 months. The contract specified that the rocket development and flight test were to be completed by a certain date in 1990. If the flight test failed, the contract would be voided; also, a severe penalty would be levied if the launch schedule was delayed without good reason.

To fulfill this contract, Chinese rocket experts decided to use a strap-on design on the highly successful Long March-2 launch vehicle which already had an international reputation.

After an extensive literature survey, the designers proposed a number of different designs; then they conducted a series of "simplified model tests" from which a large amount of experimental data were collected to provide a basis for improving the design. Faced with the challenge of an incredible amount of work, the rocket experts proceeded to solve the difficult theoretical problem of strap-on rockets within a period of 1 month.

The development of the strap-on rocket involved a large amount of high-precision machining work and required many products which were being built for the first time in this country. For example, a key component of strap-on technology is the connecting bolt, which is made of a special material with extreme hardness. In manufacturing this part, engineers and technicians started with a 170-kg block of raw material and machined it down to the final 76-kg component. Over a 2-month period, several tons of steel scrap were produced.

The satellite fairing used a new honey-comb structure more than 10 m tall; it was China's largest fairing. To produce this fairing, engineers, technicians and party officials organized a "joint three-way team" and extended the daytime shift to a 24-hour shift in order to meet the special demand; the new work schedule was followed by everyone without tardiness or request for leave. During the most intense period, a 24-hour work day was maintained for 39 consecutive days; in March of this year alone, the workers logged 2,500 hours of overtime.

By conventional rules and schedules, it would not be possible to develop a strap-on rocket in 18 months even if they worked like robots. But the Chinese rocket experts had a history of working miracles, and this time was no exception. Specifically, they collected ideas from one another and created a work procedure which reduced the drawing inspection time by half; as a consequence, the production of 2,500 special items which would normally take more than a year was completed in less than 6 months. Also, a bold new "three-in-one" method was implemented by engineers in the overall design group to shorten the drawing production time from over 2 years to less than 100 days.

Despite the extreme tight schedule, project engineers and scientists spared no details. On 13 May of this year, a slight asynchronization was detected by the engineers during a fairing test. They immediately organized a trouble-shooting team to analyze the problem; when the cause of the problem was identified, the fairing was re-worked and re-assembled.

On the morning of 17 June, when the re-assembled fairing was loaded on a truck to be shipped, three designers rushed to the scene and blocked the road. It turned out that they had been thinking about the problem overnight and had found a better solution to the problem; the huge fairing was unloaded from the truck and re-assembled after the required modification was made.

On another occasion, a "multi-point activator and analyzer" ordered from abroad failed to arrive on time. In order to avoid delaying the test schedule, senior engineer Wang Maoyi and his colleagues took the initiative to design and build a new test system in only 3 months using nearly 1,000 high-quality parts made by domestic suppliers.

The Chinese Launch Vehicle Research Institute has kept the following statistics on this project: (1) during the rocket development process, four major project reviews were conducted; (2) in February 1989 alone, 187 technical documents and more than 16,000 design drawings were examined; (3) nearly 1,000 pieces of equipment and more than 13,000 parts had been developed; (4) the success rate of more than 250 major design tests was 99 percent. Based on preliminary evaluation by government departments and ministries, nine items development by the project were considered to be state-of-the-art, and dozens of others had practical applications that would fulfill China's industrial needs.

The birth of the Long March-2 strap-on launch vehicle represents a new achievement under the spirit of

socialist cooperation. In January 1989, when an emergency meeting was announced to solicit parts suppliers for the new launch vehicle, nearly 300 factories from 26 provinces signed up for the meeting. With the support of the Ministry of Materials, the State Planning Commission, the State Commission of Science, Technology and Industry for National Defense and the Ministry of Machine-Building and Electronics Industry, 5,000 contracts were signed in just 1 day. During the following 6 months, more than 58,000 parts made of heat-resistent materials, high-strength steel, and precision alloys, with a total weight of 2,000 tons were shipped to their destinations.

When the Ministry of Energy called a special meeting to discuss the problem of coal supply and power supply for the development of the Long March-2 strap-on launch vehicle, the governors of Sichuan and Guizhou provinces gave their assurances to supply adequate power to factories working on the rocket development project, even if it meant sacrifices for their respective provinces. One factory in Sichuan Province devoted so much of its resources to the project that its income was reduced by more than 100,000 yuan in 1 month.

The full-scale vibration tower is an importance piece of equipment for testing the rocket. The organizations which accepted the task of constructing the tower, including the Ministry of Metallurgy, the Architectural Design Institute, and the Beijing Architectural Company, bravely faced the challenge of the harsh conditions of winter in Northern China, and completed the construction of this largest steel tower in Asia in less than 1 year.

Through the dedicated efforts of everyone working on the project, the miracle finally became a reality. Today the high-thrust Long March-2 strap-on launch vehicle was standing on the Xichang launch complex.

Intelligent System for Missile Training, Testing Certified

90FE0301A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 25 Jun 90 p 2

[Article by Chen Shouqin [7115 0649 4440] and Mo Niu [7817 3662]]

[Text] The "Second Artillery Intelligent System for Military Training and Testing" recently passed certification in Xian City. The system was developed by the Second Artillery Engineering College, under the direction of Associate Professor Wang Qingyun.

This computerized system shows the actual scenarios of training exercises and testing of strategic missiles using audio transmissions and graphic displays. The information provided by the system can be used by decision makers and base commanders to make timely decisions. By using models and computers to train military personnel for strategic missile operations, it is possible to save the State large expenses in maintenance, repair, and training; for example, in just one combat brigade, the construction expense of sand tables costing over 100,000 yuan can be saved. The system can also be used for command instruction in military schools.

Gallium Aluminum Arsenide Solar Cell for Satellites

90FE0163A Beijing TAIYANGNENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese Vol 11 No 2, Apr 90 pp 113-117

[Article by Min Huifang [7036 1920 5364], Zhong Jinquan [6945 6855 2938], Wang Zhenying [3769 2182 5391], and Wang Jiakuan [3769 0502 1401] of Shanghai Institute of Metallurgy, CAS, and Zhang Zhongwei [1728 1813 5898] of Shanghai Xinyu Power-Supply Plant, Ministry of Aeronautics & Astronautics Industry; see earlier brief report in JPRS-CST-89-004, 2 Feb 89, p 21]

[Text]

Abstract

In this paper, the process of preparation of $Ga_{1-x}Al_xAs/GaAs$ solar cells is described and the factors which affect the cell performance are discussed. The results of environmental tests and space standardization test of the solar cells are presented. It is shown that the conversion efficiency of the 2x2 cm^2 solar cells can be as high as 19 percent (AM1), and the error of standardization in space is +0.24 percent.

I. Introduction

Today, every country is actively developing new energy sources. Among these new sources, semiconductor cells play an important part; in particular, a relatively mature and widely used technology is silicon solar-cell technology. However, because of the rapid development of space technologies in recent years, there is growing interest in searching for a new energy source which is superior to silicon solar cells. Gallium arsenide solar cells have certain intrinsic properties which are superior to silicon solar cells in many respects. As a result, most advanced nations are competing with one another to develop this technology, and some promising results have been obtained.

GaAs has a forbidden band width (or energy gap) of 1.43 eV, which matches well with the solar spectrum; consequently, very high photoelectric conversion efficiency can be achieved. It also has a high absorption coefficient, which makes it a desirable material for thin-film cells; in addition, it has many other properties such as resistance to heat and radiation, and long lifetime, which are important for space applications.

Production techniques for gallium arsenide are becoming more mature. In addition to the widely used liquid phase epitaxy (LPE) technique, a new technique called the metallo-organic chemical vapor deposition

(MOCVD) technique is being used to fabricate epitaxial wafers. In the United States, the Soviet Union and Japan, production lines for 2x2 cm^2, 2x4 cm^2 or larger GaAs solar cells with an efficiency of 17-19 percent (AMO) have been established. Of particular interest is the CS-3 communications satellite launched by Japan in 1988; its power source consists of 80,000 2x4 cm^2 solar cells with an average efficiency of 18.9 percent (AMO).[1] This indicates that GaAs solar cells can now be used in space applications.

In this paper, the manufacturing techniques for $Ga_{1-x}Al_xAs/GaAs$ material and solar cells are described, and the factors which affect cell performance are discussed. The results of environmental tests, space flight tests and space standardization test of the solar cells are also presented.

II. Experimental Results and Discussion

1. Preparation of Gallium Arsenide Material

We use the LPE technique for the preparation of the solar cell material with Si-GaAs as a substrate and Mg as a p-type dopant. First, at a certain temperature, the substrate is kept in contact with the saturated Ga-GaAs melt which contains Mg and Al; then a p-GaAs layer is formed by the diffusion of Mg into the n-GaAs layer, and a p-n junction is obtained. Then, a $p\text{-}Ga_{1-x}Al_xAs$ window layer is grown by lowering the temperature; the value of x is controlled to be in the range 0.8-0.9.

2. Preparation of Gallium Arsenide Solar Cells

The efficiency of GaAs solar cells can be improved by taking certain basic measures which include: minimizing surface loss due to photo-reaction and photo-reflection; improving the performance of the p-n junction; increasing the diffusion length and lifetime of the minority carriers; selecting the optimum configuration of the grating electrode; ensuring good ohmic contact; and preventing contamination by impurities.

The flow diagram of the cell preparation process is shown in Figure 1, and the structure of the fabricated solar cell is shown in Figure 2. The cell areas are 1x2 cm^2, and their photoelectric conversion efficiency can be as high as 19 percent (AMl).

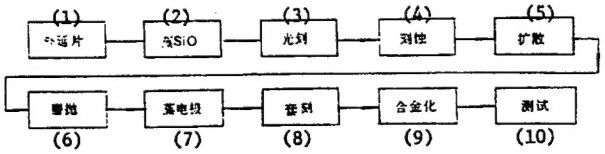

Figure 1. Flow Diagram of the Solar Cell Preparation Process

Key: 1. Epitaxial chip 2. SiO evaporation 3. Photo-etching 4. Etching 5. Diffusion 6. Polishing 7. Electrode evaporation 8. Alignment 9. Alloy formation 10. Testing

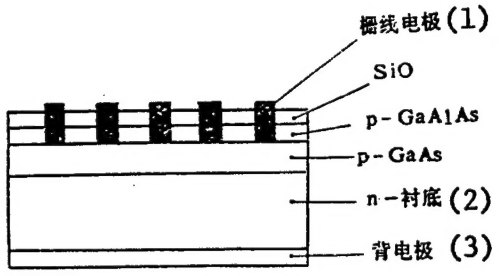

Figure 2. Solar Cell Structure

Key: 1. Grating electrode 2. n-substrate 3. Back electrode

3. Factors Which Affect the Solar Cell Performance

In the process of preparing the solar cell materials, we have studied the important factors which affect the quality of the materials and the solar cells. By understanding and controlling these factors, the performance of the materials and the solar cells can be improved; however, the relationships between these factors are not well understood and require further investigation. We shall now discuss two of these factors.

(1) Relationship between the Al content in the melts and the value of x in the $p\text{-}Ga_{1-x}As$ layer[2-4]

In an effort to produce a window layer with a high x value, we have studied the relationship between the Al content in the melts containing Mg and Zn and the x value in the $p\text{-}Ga_{1-x}Al_xAs$ layer. The x values are measured using an X-ray bicrystal diffractometer; the results are shown in Figure 3. It can be seen from the figure that the value of x initially increases rapidly, then more gradually with increasing Al content. At a given value of x, a larger amount of Al additive is required in the Mg melt then in the Zn melt.

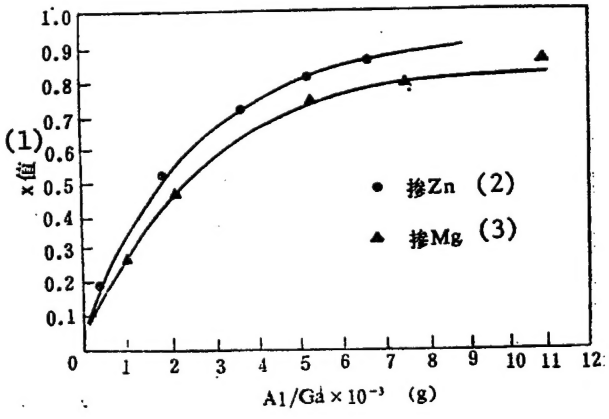

Figure 3. Relationship Between the Al Content in the Melts and the Value of x

Key: 1. x value 2. Zn-doped 3. Mg-doped

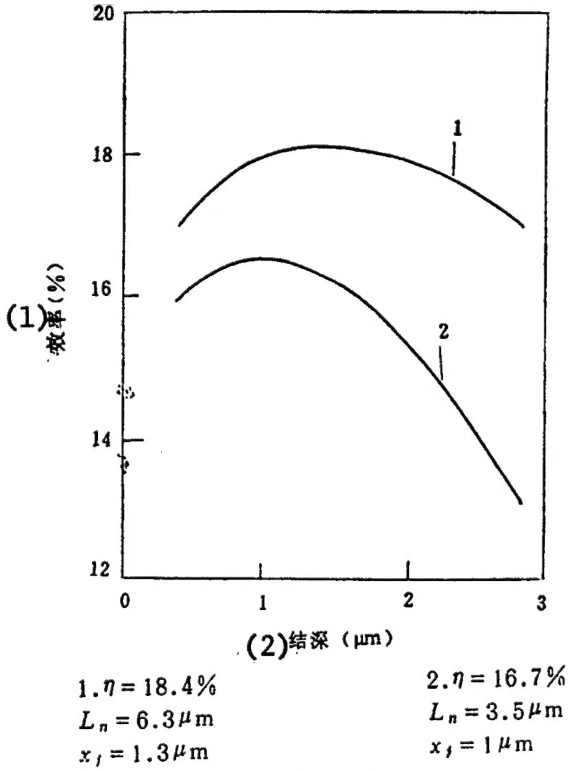

Figure 4. Relationship Between Cell Efficiency and the Depth of p-n Junction

Key: 1. Efficiency (percent) 2. Depth of p-n junction (μm)

(2) Relationship between cell efficiency and the minority carrier diffusion length and the depth of p-n junction

It has been shown from theoretical analysis and calculations[6] that higher photoelectric conversion efficiency can be achieved when there is a good match between the electron diffusion length in the active region of p-GaAs and the depth of the p-n junction. The calculations indicate that the electron diffusion length in the p-$Ga_{1-x}Al_xAs$ window layer should be greater than the thickness of the layer, and the electron diffusion length in the active region of p-GaAs should be greater then three times the junction depth. For a given electron diffusion length, the junction depth should be optimally matched to maximize the cell efficiency. Figure 4 shows the relationships between the minority carrier diffusion length, the junction depth and the cell efficiency. When L_n = 3.5 μm, the optimum junction depth is 1 μm, and the maximum cell efficiency is 16.7 percent; when L_n = 6.3 μm, the matched junction depth should be 1.3 μm, and the maximum cell efficiency is 18.4 percent.

Figure 5 shows the relationship between the measured electron diffusion length and the cell efficiency.[6-8] A comparison with Figure 4 indicates the experimental data are in good agreement with theoretical results. In Figure 5, the high-efficiency L_n values are mostly in the range of 3.5 - 5 μm, which according to theoretical

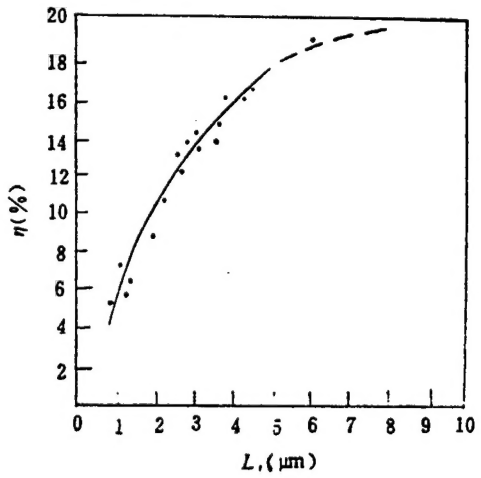

Figure 5. Relationship Between Electron Diffusion Length and Cell Efficiency

calculation should correspond to a matched junction depth of approximately 1 μm; this agrees well with the data of Figure 4.

4. Optimized Grating Electrode Design and the Application of Plasma Etching Technique

The primary design considerations for the grating electrode should be to reduce the series resistance and to minimize the light-blocking area of the electrode. However, these two considerations have conflicting requirements on the grating width; an optimum design compromise is to choose a blocking area equal to 10 percent of the total electrode area. We have designed a new lattice type grating electrode whose blockage area is only 9.5 percent. This design has the following advantages over conventional uni-directional straight-line-type grating electrodes: (1) The series resistance is reduced from R/m to R/(m.n), where m is the number of longitudinal gratings and n is the number of lateral gratings. (2) The lateral gratings provide protection to the integrated circuit from breakage in case partial damage to the gratings occurs during the electrode preparation process; therefore, the overall cell efficiency is preserved.

In the preparation of the electrodes, part of the SiO film on the electrode must be removed using photoetching techniques. In general, the photoetching process is followed by chemical corrosion, which causes severe damage at the edge of the grating, resulting in uneven edges and widened gratings. As a result, the effective light-collection area is decreased and the cell efficiency is reduced. By using a plasma etching technique to remove SiO, we have solved the problem of corrosion damage, and thus have preserved electrode quality and cell efficiency.

5. Environmental Tests of Gallium Arsenide Solar Cells[9-11]

Through ground environmental tests and flight tests in space, we have characterized the strength of the solar cells, the rigidity of the electrodes, the open-circuit cell voltage, and the short-circuit cell current and efficiency; from this data the electrical properties, the processing conditions, and the reliability and utility of the solar cells can be evaluated.

The test article [i.e., array] has a dimension of 100x62 cm^2, and weighs 35 kg. For comparison purposes, each test article has attached three GaAs solar cells and 1 silicon solar cell.

The ground environmental tests are: (1) simulated flight mechanical tests, which include impact tests, vibration test, and satellite vibration test; (2) high- and low-temperature tests where the test article is placed under temperatures of -5°C to -10° C, respectively, for 8 hours. Other tests concerning the impact intensity, direction, and the number of repetitions, and the vibration frequency, amplitude, and duration have been discussed in detail in the literature.

The flight tests in space consist of installing two test articles which had passed ground environmental tests on two retrievable satellites. The two satellites remained in space for 5 days and 8 days, respectively, during which time the test articles were subject to a vibration test, impact test, particle-radiation test, and temperature-variation test under micro-gravity conditions. Upon returning to earth, the test articles and the solar cells were carefully examined and re-tested. The measured data before and after the tests are presented in Table 1.

Table 1. Cell Parameters Before and After Flight Tests in Space (Onboard Satellites)

Cell No.	Area (cm^2)	Open-circuit voltage(V)		Short-circuit current (mA/cm^2)		Cell efficiency (percent)		Number of days in orbit
—	—	Before	After	Before	After	Before	After	—
1	2.40	0.95	0.95	24.4	24.2	13.3	13.3	5
2	2.36	0.86	0.85	25.1	23.5	12.5	12.5	5
3	1.79	0.93	0.93	22.9	22.9	7.5	7.5	5
4	2.20	0.95	0.95	28.0	27.5	13.0	13.0	8
5	2.20	0.91	0.90	26.4	25.9	13.4	13.5	8
6	2.10	0.89	0.89	21.4	21.5	7.1	7.0	8

Both the solar cells and the test articles survived the environmental test and the flight tests with no physical damage and no change in the electrical properties. This illustrates that the strength and rigidity of the solar cells and the test articles are satisfactory, and that the cells are sufficiently reliable and stable to meet the requirements of a space-borne power source.

6. Space Standardization Test of Gallium Arsenide Solar Cells[12, 13]

The space standardization test was conducted on China's first weather satellite, the Feng Yun-1. The tested cells have an area of 2x2 cm^2 and an efficiency of 15.8 percent (AMO, 100 $mW.cm^{-2}$). The satellite was in a sun-synchronous orbit. Telemetry data showed that the cell performance was stable, and the measured data had a standardization error of less than plus over minus 1 percent; the smallest error was equal to plus over minus 0.24 percent, which is comparable to current state-of-the-art accuracy. The success of the standardization test indicates that China has taken a giant step in the space application of GaAs cell technology and in the development of a new energy source for the space industry.

III. Concluding Remarks

1. The Al content in the $Ga_{1-x}Al_xAs$ layer (i.e., the x value) initially increases rapidly, then more gradually, with increasing Al content in the melt. For a given value of x, a larger amount of Al additive is required in the Mg melt than in the Zn melt.

2. Theoretical analysis and experimental data both indicate that higher photoelectric conversion efficiency can be achieved only when there is an optimum match between the minority carrier diffusion length and the depth of the p-n junction. The electron diffusion length in the active region of p-GaAs should be greater than three times the junction depth; the electron diffusion length in the p-$Ga_{1-x}Al_xAs$ layer should be greater than the thickness of the layer.

3. By using a lattice-type grating electrode design and applying plasma etching techniques, the series resistance is reduced and the collecting paths are enhanced. The fabricated GaAs solar cells have a cell area of 2x2 cm^2 and a maximum efficiency of 19 percent (AM1).

4. The results of ground enviromental tests, flight tests in space, and space standardization test show that the solar cells are sufficiently stable and reliable for space applications.

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New Fuels for Nation's Rockets

90FE0233A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 27 Jun 90 p 1

[Article by reporter Huang Yong]

[Text] Beijing, 26 Jun (KEJI RIBAO)—High-grade aluminum powder is a key ingredient for solid rocket propellant. For more than a year, scientists and engineers at the Mechanics Institute of the Chinese Academy of Sciences had devoted their efforts to the establishment of a production line for manufacturing micro-spherical aluminum powder. Their achievement has provided the solution to a difficult technical problem for China's aerospace industry.

In the past, conventional air atomization to techniques were used for the production of aluminum powder in China. This process is often unsafe because of the possibility of explosions; also, the production rate of usable aluminum powder is only 3 percent. As a result, the price of aluminum powder was very high, and its production could not meet the demand of the rapidly growing aerospace industry.

In 1984, the Mechanics Institute of the Chinese Academy of Sciences and the New Materials Research Institute of the Ministry of Aerospace Industry initiated a joint research program to develop the "ultrasonic pneumatic atomization technique" for manufacturing aluminum powder. After 3 years of intensive efforts, some preliminary accomplishments have been obtained; these accomplishments received the second-prize award for advances in science and technology. In September 1989, the Mechanics Institute allocated some of its own funds to develop a "safe production line for micro-spherical aluminum powder." This production line has a sealed enclosure containing pressurized insert gas; it is capable of producing the high-grade aluminum powder currently used by developed nations; the aluminum utilization rate had increased from 3 percent to 70 percent. The product quality from this production line meets the operational requirements of current standards.

This aluminum powder not only is an ideal fuel for spacecraft, it can also be used as a high-grade coating material.

Advances in Space Technology Recapped

90FE0233B Beijing HANGKONG ZHIZHI [AEROSPACE KNOWLEDGE] in Chinese No 6, Jun 90 p 2

[Text] During the "Aerospace Technology and Economic Development Symposium" held in Beijing in late April, it was revealed that as a result of China's entry into the international launch-service market, the Great Wall Industrial Corp. will expand services to its foreign customers and increase its level of participation in cooperative projects.

These projects cover a wide range of different areas, including: 1) Providing satellite platforms for carrying out micro-gravity experiments; taking satellite photographs for map-making; providing space stations for satellite retrieval and satellite repair; 2) Developing communications and broadcast satellites to satisfy the needs of domestic communications for developing and small countries; entering into joint ventures with foreign companies to build regional communications satellites; 3) Developing satellite ground systems which include measurement and control stations for weather satellites, communications satellites, television broadcast satellites, and earth resource satellites; and 4) Entering into bi-lateral or multi-lateral joint ventures to develop and launch applications satellites of common interest, and to share the responsibilities of satellite operation and market development.

Participants at the symposium believe that the main objectives of developing China's applications satellites in the 1990's should be to satisfy China's urgent needs and to enhance social and economic benefits. Specifically, they include the following areas: 1) Developing satellite communications and broadcast systems. These are primarily large-capacity, high-power, multiple-beam and long-service-life satellites which are designed to satisfy the needs of television education, stationary and mobile communications, and various parts of data, voice, and television broadcasts. The new communications satellite "Dong Fang Hong-3," which is currently under development, will be launched in the early 1990's; 2) Developing environmental and earth resource satellite system. A number of state-of-the-art weather satellites and earth resource satellites are currently under development; 3) Developing a satellite-based fire-fighting system. Such a system will include disaster-monitoring satellites in sun-synchronous and geo-synchronous orbits. An accelerated effort to develop such a system is being carried out to coordinate with the international and domestic 10-year disaster mitigation program, and 4) Developing a satellite navigation and positioning

system. An intensive research and development effort is under way to create a satellite navigation and positioning system which consists of two to three geosynchronous satellites. In addition, military satellites and scientific experiment satellites are also of high priority in the 1990's.

In the second half of this year, China will launch three satellites; they are: China's 12th retrievable remote-sensing satellite, to be launched by the Long March-2 vehicle; a sun-synchronous weather satellite, to be launched by the Long March-4 vehicle; and the newly developed Long March-2 vehicle with strap-on booster rockets [Long March-2E]. The launch vehicles currently under development include the Long March-1D, the Long March-2 with strap-on booster rockets, and the Long March-3A.

Satellite Mapping Network Nearly Completed

90FE0233C Beijing HANGKONG ZHIZHI [AEROSPACE KNOWLEDGE] in Chinese No 6, Jun 90 p 3

[Text] On 13 April, the National Conference on Mapping Science was held in Chengdu. It was revealed that a satellite positioning and mapping network consisting of 500 positioning and mapping points distributed across the country and the Chinese continental shelf has been established. China is now one of the countries with the largest number of mapping points.

According to the experts, except for Qinghai and Tibet and the southwest regions, the development of satellite positioning points in most parts of China is essentially completed. Initial steps have also been taken to establish an ocean-based satellite positioning network by deploying five positioning points in the Xi Sha and Nan Sha islands.

The establishment of a land-based and ocean-based satellite positioning network is of great importance. Conventional mapping techniques require carefully surveilled landmarks. Affected by weather and terrain conditions and subject to measurement errors, they are very inefficient. By using precisely designated three-dimensional positioning points, it is possible to determine the accurate location and altitude of any point on the Chinese mainland under all weather conditions; therefore, this new technique does not have the deficiencies of the old methods. It is estimated that a complete land-based and ocean-based positioning network for the Chinese mainland requires more than 600 points.

Cooling Apparatus Developed for Spacecraft Environmental Simulation

90P60071 Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 6 Aug 90 p 1

[Article by Mu Chunlei [4476 2504 7191]: "New Helium Gas Turborefrigerator Developed; Provides Cooling Source for Spacecraft Environmental Simulator"]

[Summary] A helium gas reaction-type cooler (or "turborefrigerator") utilizing a new type of gas suspension bearing has recently been developed by the Chinese Academy of Sciences' (CAS) Experimental Center for Low-Temperature Technology and has passsd its technical appraisal. This kind of refrigerator will provide a cooling source for equipment designed to simulate the environmental conditions aboard artificial satellites and other types of spacecraft. The apparatus can cool the huge metal outer surfaces of the capsules down to below minus 250°C.

The core component of the cooler is a helium gas turboexpander with an actual speed of 4500-5000 revolutions per second—a value rarely seen worldwide. The principal researchers of this project were Senior Engineer Yang Kejian [2799 0344 0494] and Assistant Engineer Wang Qun [3769 5028]. Professor Yang developed the new type of chevron-groove gas bearing while working in Britain as a visiting scholar and has reported on it at international conferences. The CAS Low-Temperature Center and the noted Swiss firm Suer-shou [phonetic] have signed an agreement for the latter to use the new gas bearing in the micro-turboexpander developed by the latter. The chevron-groove hybrid gas bearing has been granted a patent by the State Patent Bureau.

Study on the Determination of Blood Concentration of Obidoxime Salts

40091015C Beijing YAOWU FENXI ZAZHI [CHINESE JOURNAL OF PHARMACEUTICAL ANALYSIS] in Chinese Vol 10 No 4, Jul 90 pp 205-208

[Article by Guo Qingdong [6753 1987 2639] and Yu Yongxiang [0205 3057 4382], (Academy of Military Medical Science, Beijing 100850)]

[Abstract] OPA is an antidote to poisons of organic phosphorus pesticides. This paper reports the determination of Obidoxime [N,N'—oxydimethylene—bis—(pyridinium—4—aldoxime) (OPA)] diacid salt in blood with ultraviolet spectrophotometry. After selecting the protein precipitating agent (CCl_3COOH), its concentration (6 percent) and other best conditions of this determination method, the stability of OPA in aqueous CCl_3COOH (stable until 50 min) and in Na_2CO_3 solution (stable in 10 min) is studied and confirmed. The method for determination of OPA salts is devised as follows.

Put 0.4 ml blood into a 5 ml centrifuge tube containing heparin 5-6 international units, add 1.1 ml of 6 percent aqueous CCl_3COOH, shake and mix, and centrifuge for 10 min at 3600 rpm. Pipet 1.0 ml of the upper clear liquid layer with care and add 1.0 ml of 1.5 M Na_2CO_3. Measure the absorbance at λmax 352 nm with spectrophotometer. Read the OPA concentration from calibration curve, which was constructed from known quantities of Obidoxime salt added to 0.4 ml of blood.

The 1 percent absorptive sensitivity is 0.07 μg/ml of blood. The coefficients of this method for determination of 1.82-6.50 μg OPA/0.4 ml blood are 2.59 - 1.44 percent. This method was used to determine the drug concentration of three rabbits (3.8 mg/kg) and three groups of rats (4.0 mg/kg) at different times after i m OPA. The drug concentrations in blood reach maximum at about 10 min and 16 min after i m at a level of 3.8 μg/0.4 ml blood for rabbits and 2.1 μg/0.4 ml blood for rats, respectively. The T one-half's are 22 min and 14 min, respectively, and OPA disappears from rabbit and rat blood stream after 2 h and 1 h 35 mins, respectively.

A New Application of Laser in Cell Engineering—Laser Induced Cell Fusion

40091015B Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 17 No 3, Mar 90 pp 171-174

[Article by Zhang Wendi [1728 5113 6611], (Department of Physics, Qingdao University of Oceanology, Qingdao)]

[Abstract] A new method—laser induced cell fusion is put forward. The parameters of micro-beam laser and the conditions of cell fusion have been analysed and presented. It has been tested on the fertilized loach eggs detached from the body successfully. The outstanding advantages over existing methods are non-lethal, non-damage and high viability rate.

Comparison of Biological Effect of Pulsed Dye Laser Irradiation on the Retina at Different Wavelengths

40091015A Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 17 No 2, Feb 90 pp 122-125

[Article by Wang Kangsun [3769 1660 1327], Lan Zhilin [5663 0037 3829], et al., (Department of Ophthalmology, Ruijin Hospital, Shanghai Second Medical University, Shanghai); *project supported by the National Natural Science Foundation of China]

[Abstract] The retina of 44 eyes of 22 chinchilla rabbits were irradiated by pulsed dye laser light at three different wavelengths (520 nm, 590 nm, 630 nm) to compare the reactions of acute biological effect respectively.

Cyanide Injection Developed

90P60066A Beijing GUANGMING RIBAO in Chinese 3 Jun 90 p 2

[Article by Cheng Ping [4453 1627]: "85-Anticyanide First Aid Injection Receives Award"]

[Summary] The 85 cyanide injection, new drug for cyanide poison protection, good for military and civilian use, has been developed by the Department of Health Protection of the Third Military Medical University and the Sixth Institute of the Academy of Military Medical Sciences. The results obtained from animal and human testing demonstrate that the injection is fast and safe and has no side effects. The small volume of the injection makes the drug handy for emergency protection against attack from hydrogen cyanic acid chemical weapons in wartime and cyanide poisons in daily life.

Transgenic Cotton Plant

90P60066B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 26 Jun 90 p 1

[Article by Dong Zhixiang [5516 1807 5046]: "Great Achievement in Plant Gene Engineering Obtained"]

[Summary] A gene-engineered transgenic cotton plant has been obtained by the research team headed by Fan Yunliu [5400 0061 0491] of the Biotechnology Research center of the Chinese Academy of Agricultural Sciences. The researchers first designed two pesticidal gene lines, one constructed by fusing the pesticidal gene (B.t) from Bacillus thuringiensis with the report gene (GUS), and the other constructed without fusing. By inserting the two pesticidal gene lines into four varieties of cotton plants, the GUS gene of the fused line was found to be expressed in the plants and this transgenic plant inserted with the fused gene line was able to paralyze the bollworms that feed on cotton plants.

New Antimalarial Drug

90P60066C Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 19 Jul 90 p 2

[Article by Hua Zhongfu [5478 6988 3940]: "New Antimalarial Drug—Reduced Qinghaosu—Developed"]

[Summary] A safer, more effective antimalarial drug—reduced qinghaosu—has been developed by the Research Institute of Traditional Chinese Medicine. In order to combat the problem of the plasmodium resistant to classical antimalarial drug (chloroquine), the Chinese researchers started the study of qinghaosu in the 1970's and subsequently worked on qinghaosu derivatives in 1985. By lowering the recurrence rate of 5 percent and below, the new drug is said to be 10 times more effective than the original qinghaosu (artemisinine). The 100 percent cure rate, 14.5-24.7 hours' defervescence time, 64.9-69.2 hours' plasmodium-clearance time, and a recurrence rate of 1.95 percent or less obtained from clinical tests conducted on 349 patients with pernicious malaria, demonstrated that the qinghaosu compound will be the most ideal medicine to be used in malarial epidemics caused by plasmodium resistant to chloroquine and in the large-scale, on-site treatment.

Analysis of Supercomputer Problems, Gap With State-of-the-Art

90P60073b Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 31, 8 Aug 90 p 51

[Article by Shen Yan [3088 7159]: "Cost Performance of and Future Prospects for Minisupercomputers"]

[Summary] The largest obstacles to be overcome in the further development of the next generation of domestic supercomputers and minisupercomputers are integrated circuits (LSI and especially VLSI), software systems, and manufacturing techniques (including improved cooling systems for supercomputers). There is a significant gap between the nation's supercomputer technology and that of the state-of-the-art. China completed its first supercomputer, the Galaxy I, in 1983, 7-8 years after Cray came out with its Cray-1. That U.S. firm marketed its Cray-2 in 1985, and China needs 2 years (by 1992) to complete development of a new Galaxy supercomputer which is lower in performance than the Cray-2. By that time, however, the Cray-4 should be out, and the gap will have expanded. Since the U.S. has put a ban on supercomputer exports to China, our computer experts will need support from the state to establish the favorable environment necessary for continued development. We must also stress improvements in our own basic technologies in order to further develop the computer industry; this is the basic path on which we might catch up to the world state-of-the-art in supercomputing.

Novell Netware 386 Sinicized

90P60073a Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 31, 8 Aug 90 p 21

[Article by Ming Sheng [2494 3932]: "Novell Netware 386 Sinicization Development Completed"]

[Summary] The Commission of Science, Technology & Industry for National Defense's Beijing Lanshen [5663 3234] Computer Network Systems Company recently completed its development of a Sinicized version of an imported copy of the Novell Company's Netware 386 complete networked system. The Sinicized system has completely new program boot technology, preserves all the functions of the original English-language software, greatly increases the run speed on Chinese-character systems, and can be put on line with IBM mainframes and midis and with the VAX series of computers.

Netware 386 is an Intel 80386 CPU-based 32-bit high-performance multi-tasking network operating system. One file server can simultaneously support up to 250 workstations. The Lanshen Company has also completed development of a Chinese-character Novell network supported by fiber-optic communications hardware.

CNC Lathes Exported to U.S.

90P60060 Beijing ZHONGGUO JIDIAN BAO in Chinese 12 Aug 90 p 1

[Article by Sha Zuoguang [3097 0155 0342] and Li Wei [2621 0251]: "Jinan Numerically Controlled Lathes Pressing Onward Into U.S. Market"]

[Summary] On 10 August, four MJ-50CNC [computer] numerically controlled lathes bearing the inscription "Made by China Jinan First Machine Tool Plant" had arrived at Qingdao Harbor and were just about to be loaded onto a ship for a journey to the U.S. The MJ-50CNC lathe, jointly designed and developed by the U.S. firm M Company and Jinan First Machine Tool Plant (JFMT), is a high-performance fully functional product intended for sale on the European and American markets. The contract for joint development was signed by both parties in 1988; the U.S. firm has been responsible for conducting market research and for providing machine-tool development information and requirements, and JFMT has been responsible for design and manufacturing. After JFMT technicians rigorously tested the prototype for 3 months to certify it to ISO [International Standards Organization] standards, small-batch production of the four samples began in late March. In mid-June, M Co. sent four specialists to Jinan to carry out the acceptance check with their own instruments. The chief U.S. inspector commented that the prototype was the best CNC lathe he had yet seen and that he admired the Chinese for being able to produce China's highest-quality CNC lathe in the least amount of time ever for such a product. While the contract is for manufacture of 300 units, the U.S. spokesman hoped that JFMT could gear up as quickly as possible for annual output of 600 units.

New Fuzzy Controller Developed at Shanghai Engineering University

90P60074 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 32, 15 Aug 90 p 1

[Article by Wang Zhengsan [3769 2973 0005]: "Shanghai Engineering University Develops New Type of Fuzzy Controller"]

[Summary] Research into fuzzy control—an area of non-linear control that has seen rapid development worldwide—has already produced tangible benefits here in China. Recently, Professors Jiang Baozhi [1203 1405 0037] and Yan Xiulan [7051 4423 5695] of the Department of Automation at Shanghai Engineering University announced development of a new kind of fuzzy controller, as well as positive benefits from its application in an actual system. The new controller has the features of a PID [proportional-integral-differentiated or proportional-plus integral-plus derivative] controller but also permits combination control unattainable with a PID controller.

The new fuzzy controller has been tested in a certain plant's large-scale fully automatic heat-treatment system and push-rod-type continuous gas carburizing furnace for processing machinery parts (automobile gear boxes), where it has generated economic benefits. For dynamic-control situations, transient time has been reduced to one-third that with a PID controller and overshoot has been reduced to plus or minus 2°C (compared to plus or minus 9°C for a PID controller). For static-control situations, control accuracy is 0.1 percent (plus or minus 1°C), equivalent to that of the PID controller. The system runs on a Zijin-II microcomputer and uses the Pascal language.

Self-Focusing of Picosecond Pulses in Large-Core Optical Fibers

40090026A Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 10 No 6, Jun 90 (MS received 24 Oct 89; revised 5 Jan 90) pp 514-520

[Article by Li Qu, Hua Yimin, Wang Wenzhen, Liu Yangang and Chen Yingti, Department of Applied Physics, Shanghai Jiaotong University]

[Abstract] In this paper, experimental observation and theoretical analysis of self-focusing of picosecond laser pulses in large-core silica fibers are reported. The near-field intensity distribution of self-focusing light field is measured. Temporal and spectral characteristics are recorded. A waveguide model is proposed to explain the formation of ring structure of the self-focusing light.

Shape Stability of Single-Crystal Fibers Grown With Laser Heating Float-Zone Method

40090026B Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 10 No 6, Jun 90 (MS received 28 Nov 89; revised 16 Feb 90) pp 521-526

[Article by Chen Jiqin, Fu Senlin and Ji Yangyang, Graduate School, Zhejiang University, Hangzhou]

[Abstract] In the paper, the shape stability of single-crystal fibers grown by laser heating float-zone growth method is studied with zone-melt growth theory. The relation of melting zone length (1) during steady-state crystal growth to the diameters of source rod (D) and fiber (d) is explained. It is indicated that the laser heated source stability and the homogeneity of source rod are the major factors influencing the fiber diameter fluctuation. The conclusion deduced from theory agrees with the experimental results.

Optical-Fiber Interferometric Testing of Interface Mechanics of Composites

40090026C Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 10 No 6, Jun 90 (MS received 4 Jul 89; revised 13 Oct 89) pp 527-532

[Article by Zhou Chonghua, Jiang Desheng, Chen Jiaqi, Institute of Lasers, Wuhan University of Technology]

[Abstract] The mechanical measurement between fiber and medium in composites is an attractive but difficult subject. We use a single-mode optical fiber instead of ordinary fiber to be buried in polyester. When He-Ne laser light goes through the single optical fiber and reference fiber with the same length, we could test the stress and strain in the optical fiber in composites according to the two-beam interference. Many results could be obtained about the interface microcosmic mechanics in composites. This paper presents a new sensitive testing method for composites.

A New Type of Optical System in Optical Head for Magneto-Optic Disk Drive

40090026D Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 10 No 6, Jun 90 (MS received 12 Jun 89; revised 12 Jan 90) pp 552-557

[Article by Xiong Shengming and Lin Dajian, Institute of Optics & Electronics, CAS, Chengdu]

[Abstract] This paper describes a new type of optical system in optical head for magneto-optic disk drive, and expounds theoretically the basic principle for magneto-optic information read out. The system has improved the performance of optical system, reduced optical noise, and increased efficiency of optical energy. It has been applied to the development for a prototype magneto-

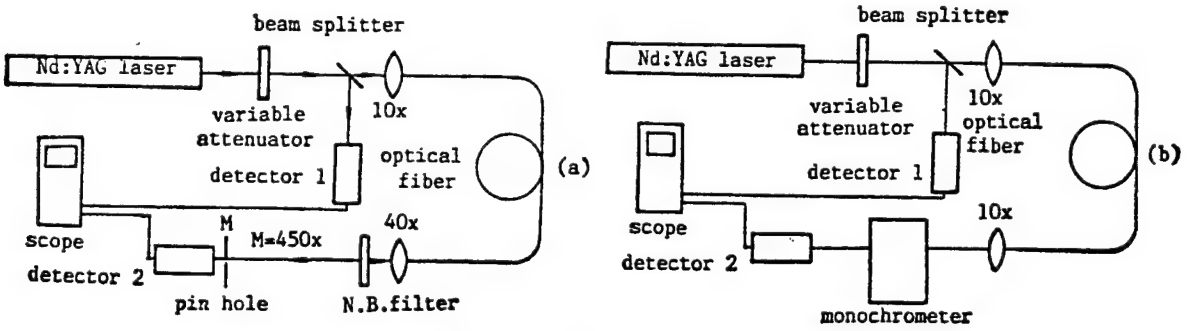


Fig. 1 Experimental Setup for Self-Focusing of Picosecond Pulses

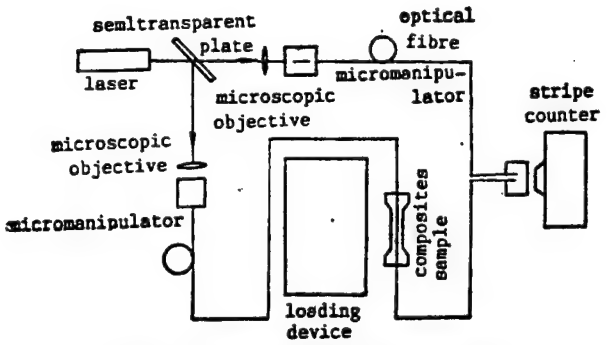


Fig. 1 Diagram of interferometric optical fibre test

optic disk (5 and one quarter inches) drive and a read-out signal-to-noise ratio of more than 50 dB has been reached.

Optical Instability in ZnS Optical Bistable Devices

40090026E Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 10 No 6, Jun 90 (MS received 28 Jun 89; revised 18 Dec 89) pp 565-569

[Article by Wang Ruibo, Li Chunfei and Zhang Lei, Department of Applied Physics, Harbin Institute of Technology]

[Abstract] In this paper we present the first observation of optical regenerative pulsation in ZnS interference-filter bistable device. Conditions for the device to be unstable are analysed. Simulation of the pulsation process has been carried out. The device is expected to be used as a clock-pulse generator in optical digital computing experiments.

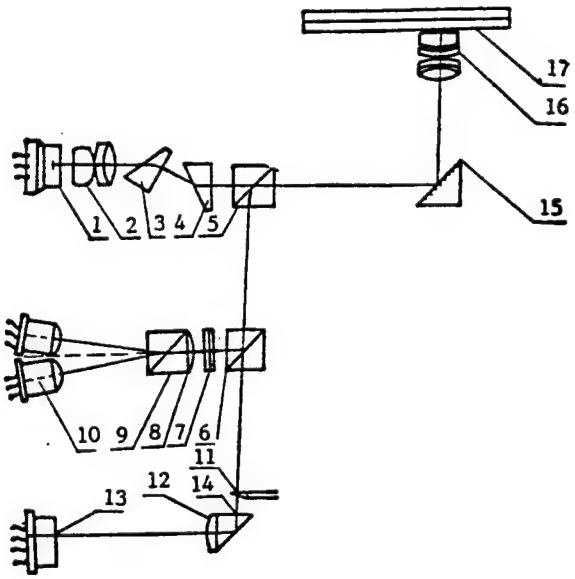


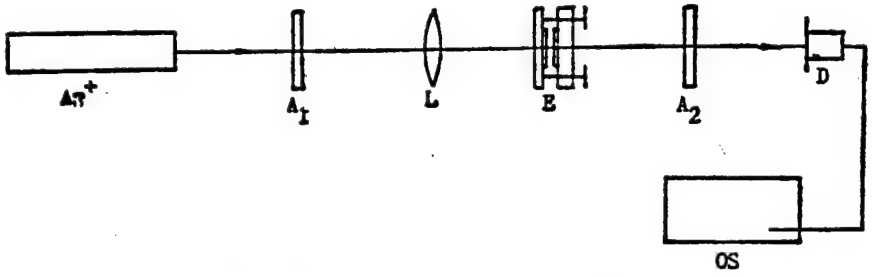
Fig. 1 New magneto-optic head

Phase Conjugation by Four-Wave Mixing of Nd:YAG Lasers in Si Single Crystal

40090026F Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 10 No 6, Jun 90 (MS received 10 Jul 89) pp 570-576

[Article by Chen Jun, Department of Optical Engineering, Zhejiang University, Hangzhou]

[Abstract] The phase conjugate wave has been obtained by degenerative four-wave mixing (DFWM) with silicon single crystal as the nonlinear medium using Q-switched Nd:YAG lasers. The reflectivity of the phase conjugate mirror (PCM) has been calculated from the theory of the



Ar+—Argon laser
A1, A2—Attenuators
L—Focusing lens
E—Etalon
D—Detector
OS—oscilloscope

Fig. 3 The Experimental Set-Up for ZnS Optical Bistable Device

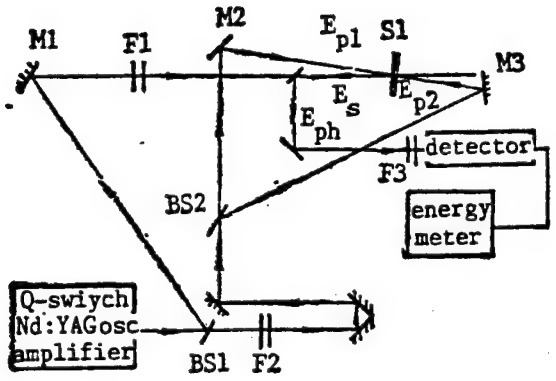


Fig. 1 Experimental arrangement for four-wave mixing in silicon

light-induced electron-hole-pair density, which produced a phase grating. Experimentally, a reflectivity of 125 percent of the PCM was obtained and the property of the compensation of the phase aberrations was demonstrated.

Study of Laser-Induced Plasma on Dielectric Thin Films

40090027A Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 10 No 4, Apr 90 pp 322-327

[English abstract of article by Ni Xiaowu, Lu Jian, and He Anzhi of the East China Institute of Technology, Nanjing, and Ma Zhi and Zhou Jinlin of the South-West Technical Physics Institute, Chengdu; received 14 May 89; revised 13 Oct 89]

[Text] By using a Mach-Zehnder interferometer and an optical delaying system, we made a time-resolved multiframe interference recording for the plasma on dielectric thin films produced by YAG laser. We have calculated the electron density and plasma shock speed from the series of interferograms, and first acquired relevant results about 15 ns pulse width (FWHM) of 1.06 μm laser interacting with dielectric thin films within 150 ns.

Key words: optical thin films; laser produced plasma; interference diagnostics.

Imaging Properties of Large Size Optical Arrays

40090027B Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 10 No 4, Apr 90 pp 350-355

[English abstract of article by Song Ruhua, Wang Junbo, and Le Shixiao of the University of Electronic Science and Technology of China, Chengdu, and Lu Baida of the Department of Physics, University of Sichuan, Chengdu; received 22 Jun 89; revised 14 Nov 89]

[Text] According to the ray optical theory, the imaging properties of optical arrays are analysed. A general imaging transfer matrix is obtained, which includes a special case of paraxial ray approximation. Furthermore,

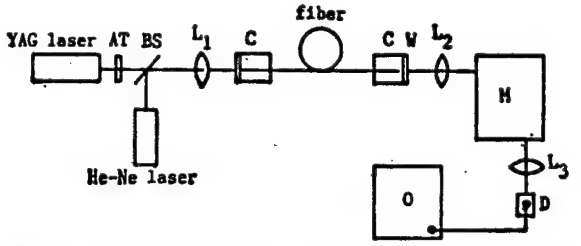


Figure 1. Experimental Setup for SRS in Liquid-Core Fiber

AT—Attenuator; W—Fused silica window; BS—Beam splitter; D—Detector; C_1, C_2—Liquid cells; M—Monochromator; L_1-10 x Microscope objective; L_2, L_3—LiF lenses; O—Oscilloscope

we show that plane arrays imaging is approximating phase conjugation, and it is the phase conjugation only for the paraxial case. Using a new pseudoconjugator—cone-shaped corner arrays, the wavefront distortion compensation is demonstrated, and the experimental results are consistent with the theory of this paper.

Key words: pseudoconjugator; arrays; paraxial optics; optical distortion.

Stimulated Raman Scattering in $CBrCl_3$ Liquid Core Fiber

40090027C Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 10 No 4, Apr 90 pp 362-364

[English abstract of article by Li Qu, Wang Cuifeng, and Chen Yingli of the Institute of Condensed Matter Physics, Shanghai Jiaotong University, and Zhang Zuming, Hua Yiming, Liu Yagang, and Wang Wenzhen of the Department of Applied Physics, Shanghai Jiaotong University; received 13 Apr 89; revised 31 Oct 89]

[Text] Eleven Stokes orders of SRS were observed in $CBrCl_3$ liquid core fiber pumped with a mode-locked and Q-switched YAG laser at 1.06 μm. Relative peak power of pumping and Stokes pulses as well as the frequency spectra of 9th, 10th and 11th Stokes light were measured. This kind of liquid core fiber can serve as an IR coherent light source beyong 2 μm wavelength.

Key words: IR coherent light; stimulated Raman scattering; liquid core fiber.

Automatic Processing of Holographic Interferogram With Intense Background

40090027D Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 10 No 4, Apr 90 pp 365-368

[English abstract of article by Lu Yueguang, Jiang Lingzhen, Geng Wanzhen, and Hong Jing of the Department of Physics, Harbin Institute of Technology; received 7 Aug 89; revised 31 Oct 89]

[Text] The principle of defects inspecting in solder joints on printed circuit board (PCB) by holographic method is

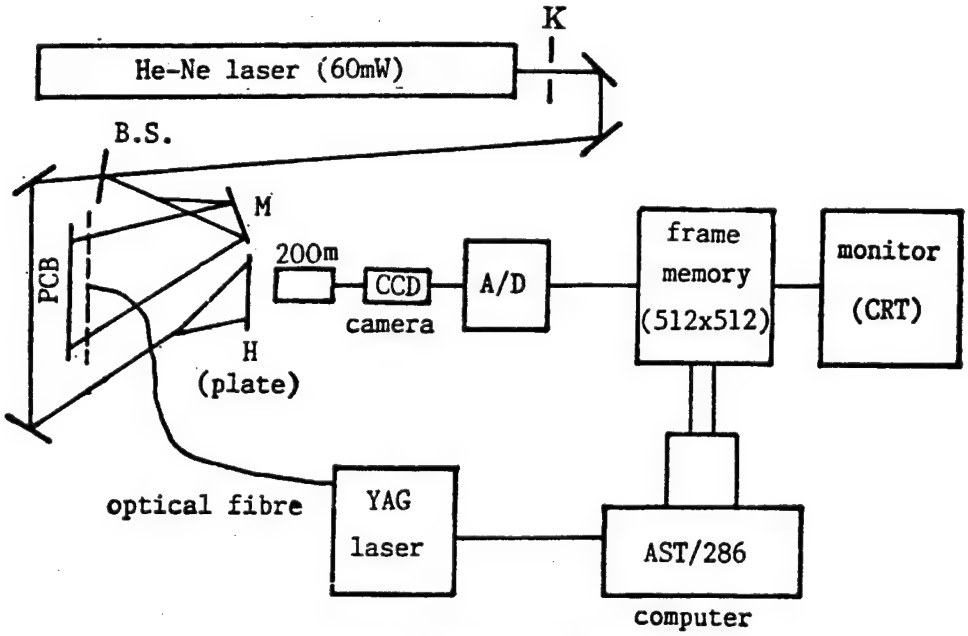


Figure 1. Experimental Setup

described. In order to process interferogram with intense background by computer, some suitable methods are suggested. We have accomplished image background and noise depressing, smoothing, thinning and recognition of the fringes. Satisfactory results have been obtained.

Key words: image processing; holographic interferometry; nondestructive testing.

Experimental Study of Laser of F_B(II) Color Centers in Na KCl Crystals at Liquid Nitrogen Temperature

40090027E Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 10 No 4, Apr 90 pp 378-381

[English abstract of article by Zhao Jiaju, Zhou Yan, Lou Yongqing, and Li Shenghua of the Department of Applied Physics, Shanghai Jiaotong University; received 9 Jun 89; revised 12 Jan 90]

[Text] A laser utilizing F_B(II) centers in Na-doped KCl crystals and operating stably at liquid N_2 temperature is described. Color center crystal was pumped by the frequency doubled output of a Q-switched Nd:YAG laser. Laser emission wavelength ranges from 2.420 to 2.542 μm. Experimental results are discussed.

Key words: laser; F_B(II) color center.

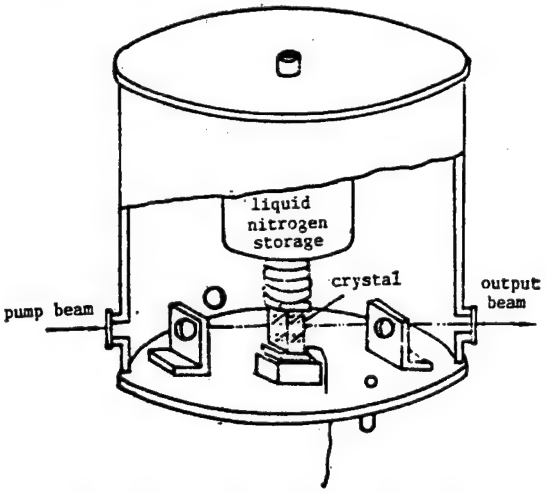


Figure 1. Complete Color Center Laser System

Foundation-Supported Research Projects at World State-of-the-Art

90P60059b Beijing BEIJING KEJI BAO [BEIJING SCIENCE AND TECHNOLOGY NEWS] in Chinese 28 Jul 90 p 1

[Article by Hu Jian [5170 0494]: "Major Basic Research Projects Supported by National Natural Science Foundation Achieve High-Level Results"]

[Text] It has recently been learned from the National Natural Science Foundation that a number of Foundation-supported major basic research projects [in the microelectronics/optoelectronics/laser crystal area] have attained results which have attracted the attention of the international scientific community.

A project directed by Chinese Academy of Sciences' (CAS) Academic Committee Member and CAS Institute of Semiconductors researcher Huang Kun [7806 2492]—"Semiconductor Superlattice Microstructures"—is considered to have expressed pioneering concepts. For the first time, the microcosmic theory of Raman scattering in semiconductor superlattices has been systematically developed.

A project led by CAS Academic Committee Member and CAS Beijing Scientific Instruments Plant researcher Guo Kexin [6753 0668 0207]—"Structure and Properties of Quasicrystals"—has already seen breakthrough advances: in 1989, ahead of schedule, the research group was able to grow a millimeter-level AlCuCO(Si) 10-sided quasicrystal, and for the first time internationally used a quasicrystal monocrystal to measure its physical properties.

A project directed by CAS Academic Committee Member and Fudan University Professor Xie Xide [6200 1585 1795]—"Research on the Structure and Electronic States of Solid Surfaces With Interfaces"—has proceeded well. The research team has prepared a Ge/Si superlattice and has developed a monatomic-layer Ge/Si superlattice controlled by RHEED [reflection high-energy electron diffraction] oscillation.

A project led by CAS Fujian Institute of Material Structure researcher Chen Chuangtian [7115 0482 1131]—"The Relationship Between the Basic Group Structure of Boron-Oxygen Compounds and Their Optoelectronic Characteristics With an Exploration of the Materials"—has conducted an in-depth study into the properties and performance of the new nonlinear optical crystal LBO [lithium triborate, LiB_3O_5] and has determined various applications for the crystal. The research group has also confirmed the higher performance of LBO crystals compared to KTP [potassium titanyl phosphate, $KTiOPO_4$] and BBO [barium borate] crystals, and has used LBO as a PS-level [?picosecond-level] optical parametric amplifier in place of a dye laser. This invention has been granted a U.S. patent.

A project directed by CAS Academic Committee Member and Nanjing University Professor Feng Duan [7458 4551]—"A Study of Polysynthetic Polydomains and Other Crystals With Modulated Structures"—has established a theory of the acoustic and nonlinear effects of quasicyclical micron superlattices and has conducted research to demonstrate the physical feasibility of the theory. This has opened up the new field of studying new materials and new devices by examining their submacroscopic microstructures.

Finally, a project led by Shandong University Professor Jiang Minhua [5592 3046 5478]—"An Exploration and Study of a Series of Metal-Organic Chromium-Compound Functional Crystal Materials"—has employed a powder technique to isolate 30 new kinds of materials with a frequency-multiplying efficiency better than that of KOP [as published; apparently a typo for either KDP (potassium dihydrogen phosphate) or KTP] and 15 kinds with a performance superior to that of urea [crystal]. They have also grown seven new types of crystals and have designed and synthesized HMBA [either hexamethylene bis(acetamide) or hydroxymethyl (methyl)benzanthracene] and other new crystals aimed at the requirements of direct frequency doubling in semiconductor lasers.

New Series of High-Speed, High-Voltage, High-Power Transistors

90P60059a Tianjin ZHONGGUO JISHU SHICHANG BAO [CHINA TECHNOLOGY MARKET NEWS] in Chinese 25 Jul 90 p 2

[Unsigned article: "Zhejiang University Scientific Research Office Markets Six New Products and Technologies"]

[Excerpt] [Passage omitted] A new series of transistor products—including a high-speed, high-voltage, energy-saving GAT [gate-associated transistor]; a high-speed, high-voltage, high-power transistor known as a VD-MOSFET [vertical double diffusion metal oxide semiconductor field-effect transistor]; and a radio-frequency power transistor known as a VV-MOSFET [vertical ... MOSFET]—utilizes both bipolar and MOS structures. These devices have excellent electrical characteristics and wide applications. [Passage omitted].

140GHZ GaAs Gunn Harmonic Oscillators

90P60062a Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 18 No 4, Jul 90 pp 107-108 (MS received Jul 89, revised Oct 89)

[Article by Cao Kangbei [2580 1660 4101] and Wang Ziyu [3769 1311 1342] of the Applied Physics Institute, University of Electronic Science & Technology of China, Chengdu: "140GHz GaAs Gunn Harmonic Oscillators"]

[Summary] A domestically manufactured millimeter-wave GaAs Gunn-diode harmonic oscillator with a maximum operating frequency of 140GHz is described.

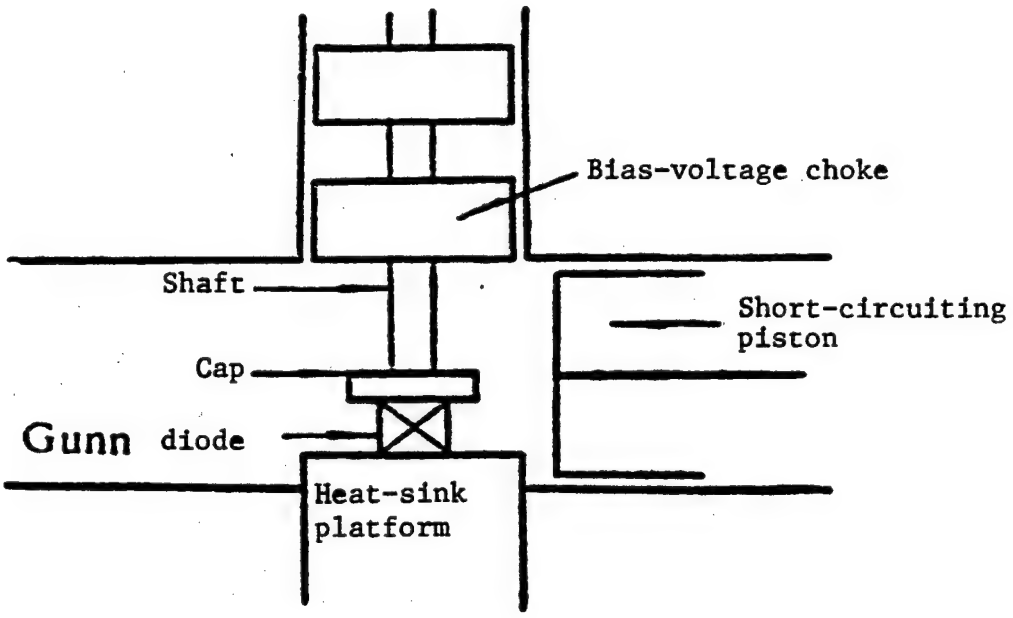


Figure 1. Diagram of 2-mm Cap-Structure Harmonic Oscillator

These packaged, commercially available diode oscillators provide an output power of 3.5 mW [milliwatts] at 139GHz, over 5 mW at 127-134GHz, and 10-13.5 mW at 120-125GHz, which satisfies the requirement for a mixer local oscillator. The active-layer thickness of the device is 1.6-2.0μm and dopant concentration is 0.9-1.3 x 10^{16}/cm^3. At a nominal operating frequency in the 70-76GHz range, power output is 30-50 mW. The diodes have the commonly seen cap structure, which has demonstrated effectiveness for high-frequency millimeter-wave devices.

A schematic of a 2-mm cap-structure device is shown in Figure 1. The output waveguide in the cavity is the WR-7 type (0.83mm high, 1.65mm wide). Cap thickness is 0.09mm, and the diameter runs from 1.40 to 1.75mm.

Gratitude is expressed to Institutes 55 and 10 of the Ministry of Machine-Building & Electronics Industry for their vigorous support.

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Surface Acoustic Wave MZOS Storage Correlators/Convolvers

90P60062b Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 18 No 4, Jul 90 pp 114-117 (MS received Oct 88, revised Nov 89)

[Article by He Shiping [0149 0013 1627], Wu Boxiu [0702 0130 0208], and Liu Guangting [0491 0342 1694] of the Radio Institute, Southeast University, and Zhou Zixin [0719 1311 2450], Yang Longqi [2799 7893 0366], and Mu Kaiming [3018 7030 2494] of Sichuan Institute of Piezoelectric & Acousto-Optic Technology: "Surface Acoustic Wave MZOS Storage Correlators/Convolvers"]

[Summary] SAW MZOS [surface acoustic wave metal-zinc oxide-semiconductor] storage correlators/convolvers are the optimum devices for analog signal processing in the VHF and UHF bands because of their programmability, large time-bandwidth product, and high signal-processing speed. They can pull out weak signals from amid high background noise and interference or jamming and are therefore used as programmable [phase-]matching filters to provide an improved signal-to-noise ratio in spread-spectrum (SS) communications systems. They are also used to change the compression slope in time-bandwidth variable linear frequency-modulated signals used in SS communications

systems and in satellite-borne synthetic aperture radar systems. Other applications of these devices include electronic countermeasures and image processing.

A schematic of the SAW MZOS storage correlator/convolver the authors have developed is shown in Figure 1. Onto the Si substrate, which has a resistivity of 15 ohm-cm, a 1000-angstrom-thick SiO_2 film is deposited via thermal oxidation, and onto the SiO_2 film a reference electrode is deposited, followed by deposition of a 2.8-μm-thick ZnO film via magnetron sputtering. After this, two pairs of interdigital transducers (IDT) with an indicated width of 18μm and an aperture of 1.9mm and one plate electrode with an interaction region of 2cm are evaporatively deposited.

The device's interaction duration is 5.2 microseconds, center frequency is 80MHz, and bandwidth is 7MHz. Insertion loss between two IDT terminals was measured at 30dB, side-lobe to main-lobe phase difference measured 25dB (theoretical value 26dB), and the calculated convolution efficiency (ratio of input power to output power) is -57dBm [decibels above 1 milliwatt].

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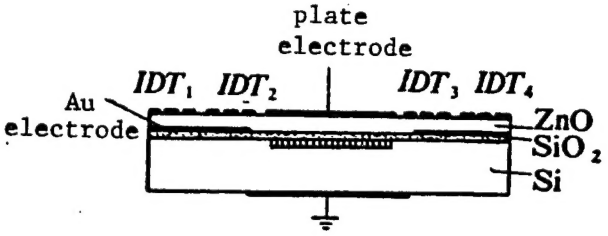

Figure 1. Schematic of Structure of SAW MZOS Storage Correlator/Convolver

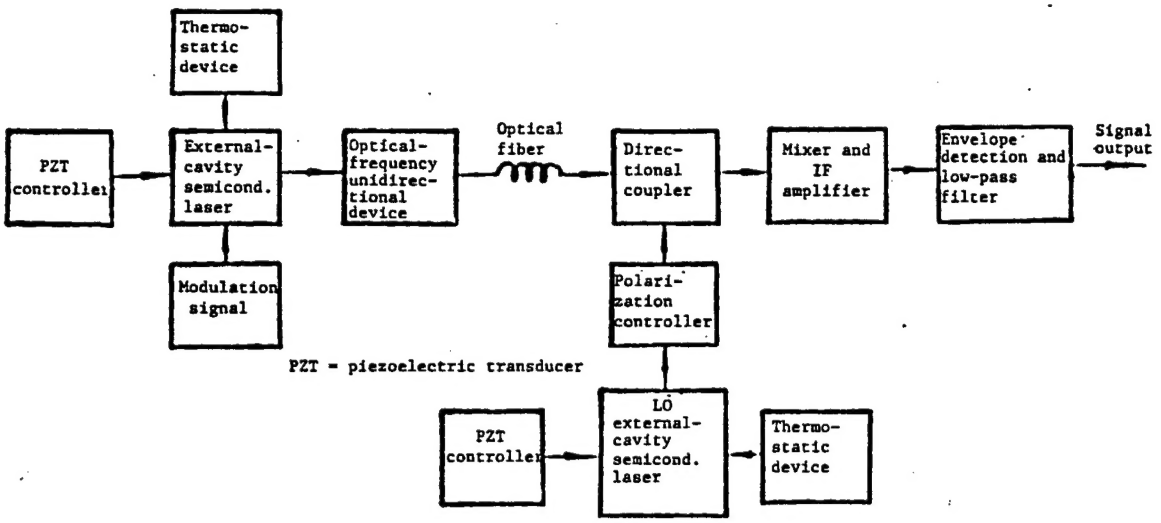

Figure 1. Schematic Diagram of Overall BIPT System

Experimental Weakly Coherent Fiber-Optic Communications System

90P60061 Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 18 No 4, Jul 90 pp 100-102 (MS received Mar 89, revised Sep 89)

[Article by Wu Yizun [0702 1744 1415], Hui Rongqing [1920 2837 1987], et al. of Beijing Institute of Posts & Telecommunications and Peng Huaide [1756 2037 1795] of the Institute of Semiconductors, Chinese Academy of Sciences: "Experimental Weakly Coherent Fiber-Optic Communications System Using 1.5μm External-Cavity Semiconductor Lasers"]

[Summary] Using 1.5-μm-wavelength InGaAsP buried-heterostructure external-cavity semiconductor lasers developed by the Chinese Academy of Sciences' (CAS) Institute of Semiconductors, researchers at the Beijing Institute of Posts & Telecommunications (BIPT) have successfully built and tested the first domestic semiconductor-laser coherent fiber-optic communications system. This weakly coherent experimental fiber-optic system can send a 70-to-140-Mbit/s signal over a 6-kilometer-long single-mode fiber.

The BIPT system, whose overall structure is shown schematically in Figure 1, employs frequency-shift-keying (FSK) modulation and falls into the heterodyne-detection category: the weak signal from the external-cavity semiconductor laser is combined at the directional coupler to a much stronger signal from the local-oscillator (LO) external-cavity semiconductor laser and fed into the heterodyne mixer. The new combined signal, called the intermediate-frequency (IF) signal, has a frequency of 1GHz in the BIPT system. The system includes a 5-millimeter-long self-focusing rod in the LO laser's external cavity, permitting an IF beat-frequency linewidth of about 10MHz; an IF frequency-stabilizing tracking circuit; and a thermostatic apparatus capable of producing a constant laser-diode temperature with an accuracy of plus or minus 0.01°C. Insertion loss for the optical-frequency unidirectional device is less than 1.2dB. The polarization controller, which has an insertion loss of less than 1dB, can provide fully directional (180°) rotation control. Input lasing power into the optical fiber is approximately -15dBm [decibels above 1 milliwatt]. After some debugging, the BIPT system had a measured bit error rate of about 10^{-9}.

This system demonstrates that a weakly coherent fiber-optic communications system built upon external-cavity semiconductor lasers can perform as stably and reliably as such a system built upon DFB [distributed feedback] lasers—the usual technique—thus reducing complexity and cost. All of the system's components and devices are domestically manufactured.

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Erbium-Doped Dye-Laser-Pumped Optical Fiber Amplifier Developed

90P60064 Beijing TONGXIN XUEBAO [JOURNAL OF CHINA INSTITUTE OF COMMUNICATIONS] in Chinese Vol 11 No 4, Jul 90 p 96 (MS received Jun 90)

[Article by Huang Baoqing [7806 5508 7230], Cao Zhong [2580 1813], Wang Qinghai [3769 1987 3189], Lian Hanxiong [6647 3352 7160], and Ye Peida [0673 1014 1129] of Beijing Institute of Posts & Telecommunications: "Dye-Laser-Pumped Erbium-Doped Optical Fiber Amplifier"]

[Summary] The optical fiber amplifier, which can directly amplify the optical carrier signal and which is a critical signal-processing component in opto-electronic and electro-optic converter ICs, has recently received much worldwide attention, especially in the Er^{3+} [triply charged erbium cation]-doped fiber form.

In the second half of 1989, our research group achieved amplification of a 1.54-μm-wavelengh optical signal by means of reverse pumping with a 0.655-μm-wavelength dye laser into a 4-meter-long Er^{3+}-doped optical fiber. For a pumping optical power of 9dBm [decibels above 1 milliwatt], net gain was 6.9dB.

In the first 6 months of 1990, our group made further progress. First, replacing the original system's three-dimensional dichroic beamsplitter with an X-type fiber-optic directional coupler provided by Institute 23 of the Ministry of Machine-Building & Electronics Industry, we realized equidirectional pumping and converted the main body of the amplifier to an all-fiber-optic system. Next, utilizing coupling technology perfected by the Chinese Academy of Sciences' Institute of Semiconductors—a technique to solidly couple into one unit the optical signal laser with the input end of a fiber-optic directional coupler—we were able to continuously stabilize the optical signal going into the fiber. After this, based on foreign research and experimentation, we optimized the signal light carrier wavelength and the pumping optical wavelength at 1.534μm and 0.6552μm, respectively. Finally, for a pumping power of 18dbm (63mW), we realized a net gain of approximately 7dB.

Further optimization of erbium-doping technique (ion density and distribution) and increased efforts at domestic production of high-power semiconductor lasers will permit the use of the Er-doped fiber optical amplifier in a domestic long-haul all-optical fiber-optic communications system.

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